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ABSTRACT

In this paper, the effectiveness of a "CyberBuch," a multimedia program for reading authentic German texts, is assessed in three areas. First, based on user evaluation of the visual interface design, the usability of the program is assessed with particular regard to user reaction to the multimedia components of the program. Second, learner behavior while using the program is tracked, and the types of multimedia links chosen are tracked. Third, the effectiveness of the program for two levels of language learning is assessed: short-term recall of vocabulary items and overall reading comprehension. Based on answers to questionnaires, users felt overwhelmingly that seeing a photograph or movie helped reinforce learning, but that the text and audio links were not as helpful. The user logs indicated that a greater proportion of picture and movie links were chosen than text links. The vocabulary tests show that vocabulary words were learned and recalled better when "defined" with picture or movie links than when only textual definitions were available. Eight figures and one table illustrate data. (Author/MAS)

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# Assessing the Effectiveness of Multimedia in Language Learning Software

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**Abstract:** In this paper, we assess the effectiveness of a multimedia program for reading authentic German texts in three areas. First, based on user evaluation of the visual interface design, we assessed the *usability* of the program with particular regard to user reaction to the multimedia components of the program. Secondly, we tracked *learner behavior* while using the program and recorded the types of multimedia links that were chosen. Thirdly, we assessed the *effectiveness* of the program for two levels of *language learning*: short-term recall of vocabulary items and overall reading comprehension. Based on answers to questionnaires, users felt overwhelmingly that seeing a photograph or movie helped reinforce learning but that the text and audio links were not as helpful. The user logs indicated that a greater proportion of picture and movie links were chosen than text links. The vocabulary tests show that vocabulary words were learned and recalled better when "defined" with picture or movie links than when only textual definitions were available.

Based on current research and theories of reading comprehension, in order for understanding and learning to take place, a reader must first activate prior knowledge, must then reorganize these existing knowledge structures or schemata, and then can link them to the new material to be learned (cf. Carlson 1990, Bernhardt 1991). Our multimedia program for the Macintosh computer aids in this process, first, by providing a contextualized overview or preview of each reading text in the form of a QuickTime movie clip, which is designed to activate in the learner's mind the text's global concepts. Second, by avoiding simple translations of unknown words and phrases in the text and instead providing other types of information in the form of hypermedia links, such as graphics (pictures), video (QT movies) and sound, in addition to the definitions of words, the learner is encouraged to infer the meaning of the word or phrase. These integrated types of information help readers formulate their own cognitive schemata, and research has shown that students learn more when they "make their own connections" rather than having connections made for them (or in this case, having translations given to them, cf. Hulstijn 1992). The interactive nature of the software allows learners to take an active role in the process, i.e. they can choose the type of information or media link that is most helpful to them. At the same time, the program provides individualized options and self-pacing ability, in order to accommodate different learning styles. In addition, increasing students' motivation to learn is the goal of any software but one which multimedia applications seem particularly successful at because they address multiple senses and thus reinforce learning.

### Key Program Features of *CyberBuch*

*CyberBuch* is a multimedia program whose prime instructional goal is to improve the comprehension skills of students who are beginning to read authentic German texts. The metaphor of a library introduces the user to the program, and from there, the following key features are accessible:

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**1. Vorschau "Preview":** This component is an advance organizer, a means of conveying global information about the text, activating top-down processing strategies of first understanding macro-level ideas before micro-level details.

**2. Native Speaker Reading the Text ("Text-Movie Link"):** Accompanying the written text is the option of hearing the text read by native speakers. Students may listen to the entire text or select any sentence they want to hear. They control the playback as one would a tape.

**3. Multiple Media Links:** Within the text, certain words are marked as "hotspots" or "hot text" and are linked to various kinds of information in the form of text, still graphics or videos. For each word, up to three different links are available. These "multiple media links" are accessed by dragging the word and dropping it on one of the three media icons. In addition to the media link selected, the word is also spoken as a default.

## Effectiveness Testing

Researchers today have moved away from the traditional comparative research (medium A vs. medium B, CALL (computer-assisted language learning) vs. non-CALL). Rather, more descriptive and evaluative studies are being conducted, among other purposes, to acquire "new theoretical information about the psycholinguistic nature of language learning and the way in which a specific computer capability of delivering instruction –its coding elements– has been shown to affect or interact with the learning process (Pederson 1987). As Clark (1983) sums it up, "We have moved from asking which medium was a better teacher to a concern with which 'attributes' of media might combine with learner traits under different task conditions and performance demands to produce different kinds of learning."

The *CyberBuch* program was pilot-tested by 44 second-year German students at the University of California, Santa Barbara in November 1993. We tested three separate but related aspects of the program and its effectiveness: *usability, learning behavior, effects on language learning.*

**1. Usability:** We first assessed the *usability* of the program, with particular regard to the multimedia components of the program based on questionnaires students filled out after they had worked with the program for two 50-minute class periods. There were a total of 42 questions, ranging from ease of use of the program, to the clarity and effectiveness of the multimedia links, and the users' perceptions of their own learning styles. The most relevant questions for this paper involve student opinions of the various links and perceptions about how they learn best.

Figure 1 shows that an overwhelming percentage (95% and 92%, respectively) agreed or strongly agreed that "The still images [picture links] clearly showed what the word means" and that "The movies clearly showed what the word means." The reactions to the statement "The German definitions [text links] for the word were clear and understandable" were mixed, with roughly a third (30%) agreeing or strongly agreeing, a third (32%) uncertain and a third (35%) disagreeing or strongly disagreeing. However, according to students' verbal and written comments beyond the questionnaire, this is due *not* to the type of link, i.e. textual, but rather to the difficulty of understanding definitions in German.

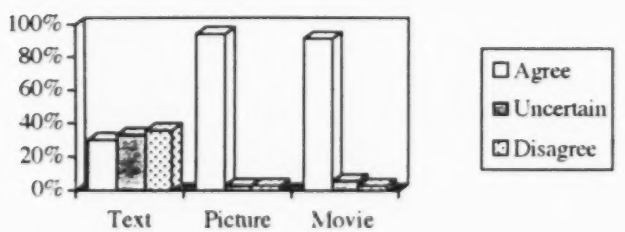


Fig. 1. Clarity of links

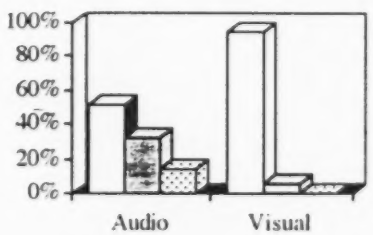


Fig. 2. Helpfulness of links for learning

Similarly, Figure 2 shows that an overwhelming percentage (95%) agreed or strongly agreed that "Seeing a photograph or movie [visual link] helped to reinforce learning." However, only about half (51%) agreed or strongly agreed that "Hearing the words spoken [audio link] helped to reinforce learning."

Students were also asked to rank the different media links in order of which helped them to learn/remember individual vocabulary words best, with 1 = helps most, 4 = helps least. The striking results are that nearly half

(43%) of the students ranked pictures as helping the most and the other half (46%) ranked movies as helping the most, while 51% ranked textual definitions as the third most helpful link and 68% ranked hearing the word spoken as the fourth most useful link (see Figures 3 and 4).

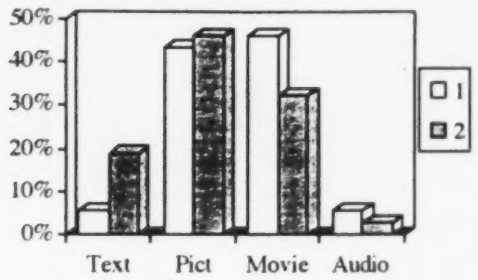


Fig. 3. Ranking of most useful links

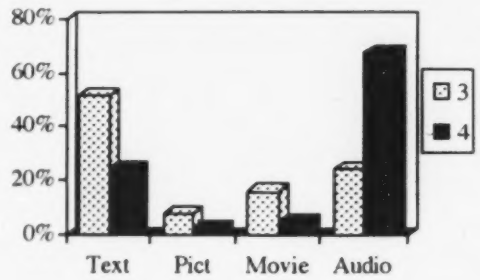


Fig. 4. Ranking of least useful links

**2. Learner Behavior:** Secondly, we tracked *learner behavior* while they used the program, hypothesizing that the picture and movie links would appeal to students and they would choose such links to a greater degree than "typical" textual or definitional links. The logs recorded provide data about which links were chosen and which ones were not used at all for both days that the program was used.

After learners had used the program for two class periods, a "surprise" vocabulary test was given, consisting of 17 words. The words were selected to represent the different multimedia links: 6 of them had only text links (definitions in German), 5 had only picture + text links, 5 had only movie + text links, and 1 had all three links (picture + movie + text). It should be noted that the audio component was included by default with *all* of the links. In this paper, we are restricting ourselves to the log data from these 17 words (and excluding the other 59 words in the program with links).

The data show that when text links were available (17 words x 44 students = 748 available links), 38% of these links were chosen. While there were fewer available picture and movie links (6 x 44 = 264 for each type), they were chosen to a much greater degree, 58% and 74%, respectively.

**Arrow shows number of available links for each media type.**

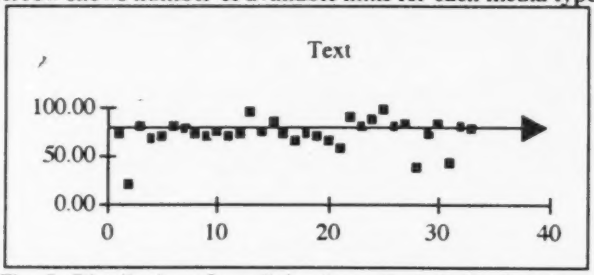


Fig. 5. Distribution of text links chosen by individual students

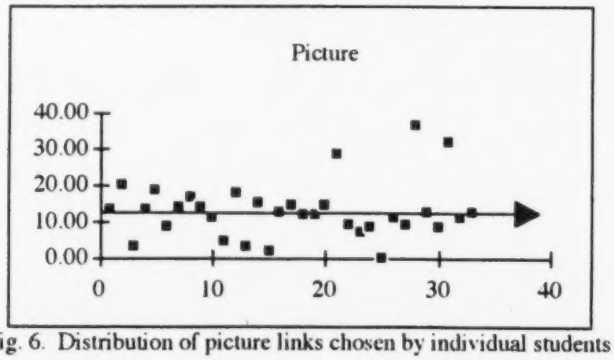


Fig. 6. Distribution of picture links chosen by individual students

Figures 5-7 show the distribution of all the media links chosen by individual students, including multiple selection of a link. The arrows show the number (percentage) of available links for each type.

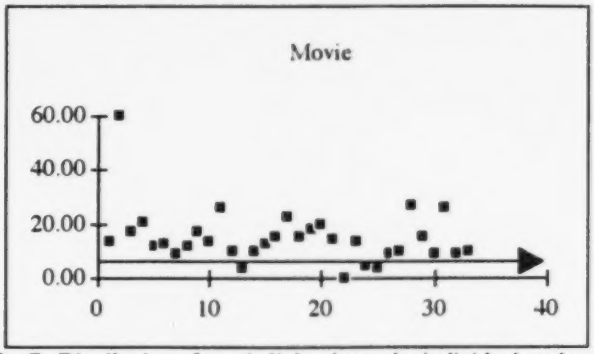


Fig. 7. Distribution of movie links chosen by individual students

In addition to tracking the chosen links for these 17 words, we asked learners on their vocabulary quizzes to specify which link they thought helped them learn the word. We then compared these "self-reported" data to the logs which recorded actual behavior and found a significant dependence between the type of link chosen and whether learners reported that that particular type of link was useful. For the text links, there was a negative relationship (Pearson $\chi^2$ (1) = 51.67, $p < 0.05$), i.e., when text links were chosen, students named a *non*-text link as being most helpful in 53% of the cases. In less than half of the cases (47%) a text link was found to be useful. On the other hand, for the picture and movie links, there was a positive relationship for both types of links between the actual choice of a link and reporting that it was useful. For picture links, Pearson $\chi^2$ (1) = 20.26, $p < 0.05$, i.e., when picture links were chosen, students reported that the picture link *was* helpful in 57% of the cases; for movie links, Pearson $\chi^2$ (1) = 26.85, $p < 0.05$, i.e., when move links were chosen, students stated that the movie link was helpful in 74% of the cases.

**3. Effects on Language Learning:** Thirdly, we assessed the *effectiveness* of the program for two levels of *language learning*: short-term recall of vocabulary items and overall reading comprehension. We first wanted to determine whether there are any effects of the multimedia links on the learning of individual vocabulary words. A vocabulary test of 17 words, as described in Section 2. above, was administered to the students after they had used the program for two 50-minute class periods. Students were not forewarned that they would be tested, so they were not consciously trying to learn new words. The same test was administered after two weeks, again without telling the students that they would be re-tested. Results of both tests, showing the number of correct answers, are presented in Figure 8. Test words are further categorized as to the link which students reported as having helped them learn the word. It should be noted that of the possible number of answers to the vocabulary test (17 words x 44 students = 748), students made only 331 and 293 entries, respectively, on the two tests.

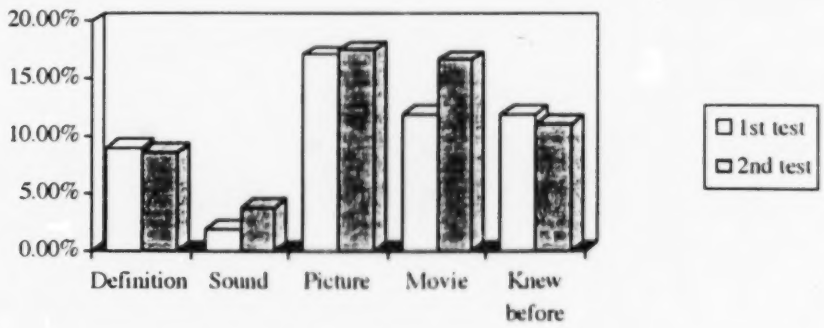


Fig. 8. Correct answers out of total number of entries on vocabulary tests

Statistical tests to determine the correlation between the multimedia links chosen for each word and whether the word was learned correctly did not prove significant (see Table 1). However, a positive relationship was found for all types of links which could be chosen. When text links were chosen for words which had such links available and an answer was given on the first vocabulary test, 77% of the words were learned correctly and only 23% of the answers were incorrect. When picture links were chosen for words which had picture links, 75% of the answers were correct, and similarly, for the words with movie links, 79% were correct.

Table 1. Correlation between media link chosen and vocabulary test results

| Vocabulary | Text | | Picture | | Movie | |
|---|---|---|---|---|---|---|
| test result | chosen | not chosen | chosen | not chosen | chosen | not chosen |
| total wrong | 47 | 35 | 13 | 18 | 5 | 16 |
| total right | 132 | 117 | 60 | 54 | 15 | 60 |
| pct. wrong | 14.2% | 10.6% | 9.0% | 12.4% | 5.2% | 16.7% |
| pct. right | 39.9% | 35.4% | 41.4% | 37.2% | 15.6% | 62.5% |
| | N=179 | N=152 | N=73 | N=72 | N=20 | N=76 |
| | Pearson $\chi^2$ (1) = 0.460, p =0.497 | | Pearson $\chi^2$ (1) = 1.115, p =0.291 | | Pearson $\chi^2$ (1) = 0.144, p =0.704 | |

Striking is the fact that in the second "surprise" vocabulary test two weeks later, almost the same total number of correct answers were given: 249 immediately after using the program for 2 days, and 235 two weeks later. Broken down by type of link, there is in fact a slight improvement in the percentages: of the words with text links, 83% of the answers given were correct; of the words with picture links, 90% were correct; of the words with movie links, 82% were correct.

A significant dependence was found between the self-reported data from the users when the text link was reported as most helpful in learning a word and whether the word was actually correct on the vocabulary test. The Pearson $\chi^2$ (1) = 3.89, $p < 0.05$, i.e., when students reported that a text link had been most useful for remembering a word, their answers on the vocabulary test for that word were correct in 68% of the cases. While no significant dependence was found for the cases where picture or movie links were thought to be most helpful, there was a positive relationship in both cases, and similar percentages of correct answers were given: 75% and 83%, respectively.

In order to test overall reading comprehension, students were asked to write a "recall protocol" of the story. This technique of summarizing a text in one's native language is widely used in assessing reading comprehension in both first and second language acquisition. The hypothesis was that the QuickTime movie preview would provide students with a global meaning of the text and that the other features, such as the movie-text link, which allowed them to hear the entire text read by native speakers, would also contribute to understanding.

However, the pilot test results of the recall protocols showed very poor comprehension. These results can be attributed to two main factors: first, the actual content of the preview, while aesthetically appealing, was much too subtle, and second, there were some technical limitations. These limitations revolved around the fact that the movie (2:45 min.) was too large to load on each student's hard drive and therefore had to be shown to each class as a group at the beginning of the hour. Students were *not* able to watch the movie again, individually, whenever they chose to. In addition, no headphones were available to students, so whenever a student chose a link or played the entire narration of the text, everyone else in the room would hear it. This may have deterred students from using the text-movie link feature, and in fact, only a few ventured to use this feature at all.

The preview is currently being redone and subsequent testing of the assumption that only knowing the meaning of individual words does *not* imply or insure understanding of a text will be conducted. With a more explicit preview, the effects of multimedia information on the higher-level process of comprehension of the text as a whole can then be assessed.

**Summary and Conclusions**

In summary, in assessing the effectiveness of our multimedia software in improving reading comprehension, we first investigated the usability of the program in terms of clarity of the different links (text, picture, movie). Users found the text links (definitions in German) the least helpful, probably due to the

difficulties in understanding the German rather than to the type of link. On the other hand, picture and movie links were ranked as the most helpful types of links. (In the next testing phase, we will both improve the definitions in German as well as add a second "layer" of help, consisting of English descriptions or translations of the words or phrases.)

We then examined the data from the user logs to determine which links were chosen and whether there was a correlation between which links were actually chosen and which were reported to be most helpful. A statistically significant dependence was found for all three types of links. In the case of text links, there was a negative relationship: when a text link was chosen, users did not find this link helpful in more than 50% of the cases. However, in the case of picture and movie links, when either of these links was chosen, users did find the link helpful in 57% and 74% of the cases, respectively.

The data from the two vocabulary tests, administered immediately after the program had been used for two class periods and then again two weeks later, show, first of all, very little attrition of correct answers after the two week interval, and secondly, a positive, although not significant, correlation between the type of link chosen and whether the word was learned correctly. When text, picture or movie links were chosen for words which had such links available, high percentages of correct answers were given (77%, 75%, and 79%, respectively).

In conclusion, students showed a definite preference for the picture and movie links (over the textual and audio links), both in their responses on the questionnaires about which links were most helpful, as well as in terms of which links they actually chose when using the program. While the movies were found to be most useful, the QT movie was, compared to the physical clarity of the textual and picture links, of much lower quality. This suggests that although the quality of the links was uneven across types of links, the more important factor appears to be type of link.

In addition, this is supported by 1) the statistically significant *positive* dependence of chosen picture and movie links with students reporting that these two types of links were helpful, and 2) the statistically significant *negative* dependence when text links were chosen and students reported them as useful.

In terms of the effectiveness of the different types of links for learning vocabulary words, there was a positive, though not significant, relationship between type of link chosen and whether the word was learned correctly. A possible contributing factor which was not included in this analysis is the fact that the program allows multiple links to be chosen in any combination, and therefore attributing learning to a single type of link for each word may not be warranted. Future testing will address this issue.

While this pilot test only suggests that visual types of links or information may be preferable to textual links, future tests will examine the hypothesis that students with different learning styles, e.g. visual, auditory, or textual, prefer different media types of information. If this hypothesis is then confirmed, we could consider this to be strong support for the notion that multimedia systems bring a new dimension to educational software because they can be adapted to individual learning types.

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